

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-286218

(43)Date of publication of application : 13.10.2000

(51)Int.Cl.

H01L 21/304
B24B 37/00

(21)Application number : 11-088157

(71)Applicant : NIKON CORP

(22)Date of filing : 30.03.1999

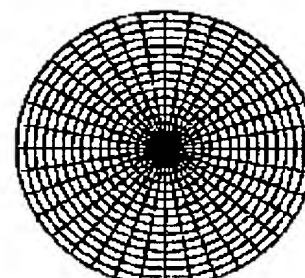
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(54) POLISHING MEMBER, POLISHING EQUIPMENT AND POLISHING METHOD

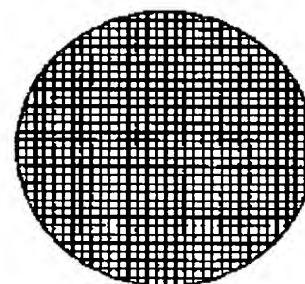
(57)Abstract:

PROBLEM TO BE SOLVED: To make occurrence of scratches difficult, and increase polishing rate by a method, wherein a surface is composed of non-foaming high molecular polymers, and a groove structure is provided on the surface, and when the grooves further intersect with each other, the intersecting angle is set to a prescribed angle or larger.

SOLUTION: A surface is composed of non-foaming high molecular polymers. Furthermore, a groove structure of the surface is made in combination with concentric and radiant grooves, or in combination with spiral and radial grooves, or only lattice grooves. For the case of groove structure, an intersecting angle becomes about 90°. In the case of the radial grooves, the intersecting angles at an intersecting point where a plurality of grooves constituting the radiant grooves intersect with each other are set to about 2° or larger. Namely, a sharp end will not be formed on the surface. For this reason, when the plurality of grooves are provided at equal angle intervals, it is preferable that the grooves be not formed exceeding 180 grooves. Furthermore, it is preferable that various lengths of the plurality of grooves be mixed with short or long ones and that terminals at a central side of the short grooves be disposed concentrically near the center.



(a)



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CLAIMS

[Claim(s)]

[Claim 1] In the condition of having had the polish head and polish member holding a polish object, and having made the abrasive material intervening between said polish members and said polish objects In the polish member used for the polish equipment which grinds said polish object by making said polish member and said polish object displaced relatively The polish member characterized by for said polish member consisting of the macromolecule polymer which is not foamed on the front face at least, preparing slot structure in said front face, and not having a still sharper edge on said front face.

[Claim 2] The include angle with which said slot structure consists of two or more slots which have two or more intersections and which the slot in said intersection intersects is 2. Polish member according to claim 1 characterized by not having the acute angle of under a degree.

[Claim 3] The polish member according to claim 1 characterized by for said slot structure consisting of two or more slots which have two or more intersections, and not having an edge with a radius of curvature of less than 50 micrometers into the part of said slot.

[Claim 4] said slot structure -- or [any of the combination of a spiral slot and a radial slot, the combination of a concentric circular groove and a radial slot, or a grid-like slot] -- from -- claims 1, 2, and 3 characterized by changing -- a polish member any or given in 1 term.

[Claim 5] claims 1-4 to which said giant-molecule polymer is characterized by being an epoxy resin, acrylic resin, polyester resin, vinylchloride resin, and any or one or more resin chosen from the group of polycarbonate resin -- a polish member any or given in 1 term.

[Claim 6] The polish approach characterized by for said abrasive material to contain a cerium oxide particle with a particle size of 200nm or less in the polish approach which grinds said polish object by making said polish member and said polish object displaced relatively using the polish head holding a polish object, and the polish member to which the front face changes from a non-foamed macromolecule polymer at least in the condition made the abrasive material intervene between said polish members and said polish objects.

[Claim 7] said polish member -- claims 1-5 -- the polish approach according to claim 6 characterized by being a polish member any or given in 1 term.

[Claim 8] The polish approach characterized by to have the phase add a load gradually between said polish objects and said polish members in the polish approach which grinds said polish object by making said polish member and said polish object displaced relatively in the condition made the abrasive material intervene between said polish members and said polish objects, using the polish head and the polish member holding a polish object.

[Claim 9] In the condition of having had the polish head and polish member holding a polish object, and having made the abrasive material intervening between said polish members and said polish objects The load device in which an adjustable load is given between said polish objects and said polish members in the polish equipment which grinds said polish object by making said polish member and said polish object displaced relatively, The polish member migration device which moves a polish member, and the polish object migration device which moves a polish object, Each load detection device for detecting the load of migration of one of the two of said polish member migration device and said polish object migration device, or both, Polish equipment characterized by having a feedback mechanism for controlling the load which said load device gives based on the value of the load detected according to said one of load detection devices.

[Claim 10] Using the polish head and polish member holding a polish object in the condition of having made the abrasive material intervening between said polish members and said polish objects In the polish approach which grinds said polish object by making said polish member and said polish object displaced relatively The polish approach characterized by having the phase of adjusting the load between said polish

objects and said polish members so that said polish object or the migration load of said polish member may become fixed.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a suitable polish member to use for flattening polish of the semiconductor device carried out in the process which manufactures semi-conductors, such as ULSI, polish equipment, and the polish approach.

[0002]

[Description of the Prior Art] The process of a semi-conductor manufacture process increases with high integration of a semiconductor integrated circuit, and detailed-izing, and it is becoming complicated. The front face of a semiconductor device is becoming necessarily flat [in connection with this] less. Existence of the level difference in a front face causes the stage piece of wiring, increase of local resistance, etc., and brings about an open circuit and the fall of electric capacity. Moreover, in an insulator layer, it leads also to withstand voltage degradation or generating of leak.

[0003] In connection with the light source wavelength of optical lithography becoming short with high integration of a semiconductor integrated circuit, and detailed-izing, and on the other hand, the so-called NA becoming large the number of open lots, the depth of focus of a semi-conductor aligner is becoming shallow substantially. In order to respond to the depth of focus becoming shallow, flattening on the front face of a device is demanded more than former. As an approach of carrying out flattening of such a semi-conductor front face, the chemical mechanical polish (referred to as CMP from Chemical Mechanical Polishing or Chemical Mechanical Planarization, and this) technique is considered to be a promising approach.

[0004] CMP It is carried out using equipment as shown in drawing 4 . 1 is CMP at drawing 4 . For a polish object and 3, as for a polish object (wafer) and 5, a polish object attaching part (polish head) and 4 are [equipment and 10 / an abrasive material feed zone and 6] abrasive materials. The polish object 10 sticks a scouring pad 2 on a surface plate 7. As a scouring pad 2, the thing of the shape of a sheet which consists of foaming polyurethane, or the thing which becomes a front face from non-foamed resin with slot structure is used. The polish head 3 is rotated with a suitable means (100), and rotates the polish object 10 with a suitable means (101). As for a wafer 4, a polished surface-ed is ground by operation of an abrasive material 6 and a scouring pad 2 in this process.

[0005] About the process stability of CMP equipment, it is also required that the homogeneity and surface smoothness which were stabilized also when the processing number of sheets of a scouring pad increased are shown, and also an open circuit of a device or the point of dielectric breakdown to a scratch (blemish) cannot be found.

[0006]

[Problem(s) to be Solved by the Invention] In conventional CMP equipment, the hard scouring pad which consists of non-foamed resin had a low inclination compared with the scouring pad with which the inclination which a blemish tends to produce is in a wafer, and a polish rate consists of foaming polyurethane, although the level difference dissolution of a pattern was good. The purpose of this invention is for generating of a blemish to be unable to take place easily and offer a scouring pad with a high polish rate, polish equipment, and the polish approach.

[0007]

[Means for Solving the Problem] We repeated the experiment and investigated by performing the cause of blemish generating of a wafer. First, as a result of investigating the scouring pad itself, it found that a problem was in the slot structure formed in the front face of the hard scouring pad which consists of non-foamed resin. Weld flash may arise on that front face at the time of this slot structure formation. This weld flash may separate during polish. This weld flash makes a polish object, i.e., a wafer front face, generate a

blemish. Furthermore, it also found it that this weld flash serves as a nucleus, condensation of a slurry arises, and the condensed slurry damages a wafer front face.

[0008] Furthermore, the torque of the surface plate rotation motor at the time of polish, the torque of a polish head rotation motor, and the load of a rocking device were measured. Consequently, in order to grind the wafer which is a polish object by the polish member, when it ground by applying a predetermined constant pressure between a polish member and a polish object from the time of polish initiation, the torque (load) of a polish head went up rapidly at the time of polish initiation, and carried out asymptotic to constant value gradually, and it found falling at the time of polish termination. And by the rapid rise of this torque, heat occurred in the polished surface-ed of a wafer, and vibration with an excessive wafer was caused. Furthermore, the rapid rise of torque raises the probability to cause unsteady contact on foreign matters which exist on the surface of a scouring pad, such as a slurry and an aggregate of polish dregs. We found that these were the big causes of blemish generating of a wafer. These caused blemish generating of a wafer also not only in the hard scouring pad which consists of non-foamed resin but in the soft pad.

[0009] Then, in order that this invention may solve the above problem, it is in the condition of having had the polish head and polish member holding "polish object in the first place, and having made the abrasive material intervening between said polish members and said polish objects. In the polish member used for the polish equipment which grinds said polish object by making said polish member and said polish object displaced relatively Said polish member consists of the macromolecule polymer which is not foamed on the front face at least, slot structure is prepared in said front face, and the polish member (claim 1) characterized by not having a still sharper edge on said front face" is offered.

[0010] The include angle to which the "aforementioned slot structure consists of two or more slots which have two or more intersections, and the slot in said intersection intersects the second is 2. Polish member (claim 2)" according to claim 1 characterized by not having the acute angle of under a degree is offered. The third is provided with "the polish member (claim 3) according to claim 1 characterized by for said slot structure consisting of two or more slots which have two or more intersections, and not having an edge with a radius of curvature of less than 50 micrometers into the part of said slot."

[0011] the fourth -- "-- said slot structure -- or [any of the combination of a spiral slot and a radial slot, the combination of a concentric circular groove and a radial slot, or a grid-like slot] -- from -- claims 1, 2, and 3 characterized by changing -- polish member (claim 4)" any or given in 1 term is offered. the fifth -- "-- claims 1-4 to which said giant-molecule polymer is characterized by being an epoxy resin, acrylic resin, polyester resin, vinylchloride resin, and any or one or more resin chosen from the group of polycarbonate resin -- polish member (claim 5)" any or given in 1 term is offered.

[0012] The sixth "using the polish head holding a polish object, and the polish member to which the front face changes from a non-foamed macromolecule polymer at least in the condition of having made the abrasive material intervening between said polish members and said polish objects By making said polish member and said polish object displaced relatively, the polish approach (claim 6) characterized by said abrasive material containing a cerium oxide particle with a particle size of 200nm or less" is offered in the polish approach which grinds said polish object.

[0013] the seventh -- "-- said polish member -- claims 1-5 -- polish approach (claim 7)" according to claim 6 characterized by being a polish member any or given in 1 term is offered. The eighth "using the polish head and polish member holding a polish object in the condition of having made the abrasive material intervening between said polish members and said polish objects By making said polish member and said polish object displaced relatively, the polish approach (claim 8) characterized by having the phase of adding a load gradually between said polish objects and said polish members" is offered in the polish approach which grinds said polish object.

[0014] The ninth "in the condition of having had the polish head and polish member holding a polish object, and having made the abrasive material intervening between said polish members and said polish objects The load device in which an adjustable load is given between said polish objects and said polish members in the polish equipment which grinds said polish object by making said polish member and said polish object displaced relatively, The polish member migration device which moves a polish member, and the polish object migration device which moves a polish object, Each load detection device for detecting the load of migration of one of the two of said polish member migration device and said polish object migration device, or both, The polish equipment (claim 9) characterized by having a feedback mechanism for controlling the load which said load device gives based on the value of the load detected according to said one of load detection devices" is offered.

[0015] The tenth "using the polish head and polish member holding a polish object in the condition of

having made the abrasive material intervening between said polish members and said polish objects In the polish approach which grinds said polish object by making said polish member and said polish object displaced relatively The polish approach (claim 10) characterized by having the phase of adjusting the load between said polish objects and said polish members so that said polish object or the migration load of said polish member may become fixed" is offered.

[0016]

[Embodiment of the Invention] The scouring pad of the [operation gestalt 1] book operation gestalt does not have weld flash in the slot structure formed in the front face. Therefore, although it was also important to take the slot structure forming method which weld flash does not generate, therefore to carry out processing which accustoms the front face of the scouring pad which slot formation finished in the first place, in this invention, it noted losing the weld flash which separates from a scouring pad during polish.

[0017] The crossover include angle in the intersection when two or more slots where the slot structure of the scouring pad of this operation gestalt constitutes slot structure cross does not have the acute angle of 2 or less times. By this, the weld flash which separates during polish can be reduced greatly. for this reason -- being alike -- the combination (drawing 1 (a)) of the slot of concentric circular and a radial -- the combination of a radial or the structure (drawing 1 (b)) of only a grid slot is the most effective in it being spiral. In the case of such slot structures, a crossover include angle turns into 90 degrees. It is made for the crossover include angle in the intersection (usually center section of the scouring pad) when two or more slots which constitute the slot on the radial cross in the case of the slot on the radial to have the include angle of 2 times or more. for this reason -- being alike -- when two or more slots which constitute the slot on the radial are prepared by the equiangular distance, it is desirable not to form two or more slots more than 180. Furthermore, it is also desirable to arrange the termination by the side of the core of the scouring pad of two or more slots of the shorter one which mixes together the die length of two or more slots which constitute the slot on the radial alternately with merits and demerits, and constitutes the slot on the radial near the center of a scouring pad to concentric circular. Thus, it is desirable not to have a sharp edge in the processing side of a scouring pad, and it is desirable not to specifically have an end face with a radius of curvature of less than 50 micrometers in the processing side of a scouring pad.

The [operation gestalt 2] book operation gestalt is a slurry used combining the operation gestalt 1.

[0018] This slurry is a pile to a lifting about condensation. The slurry which contained cerium oxide as a slurry which is hard to condense is used preferably. Many slurries which generally contained the silicon dioxide (SiO₂) are used for polish of the dielectric of CMP. Although this slurry is excellent in stability, it has the property which condenses and is easy to form glass. This aggregate is condensed on the surface of a scouring pad. Although an aggregate does not cause a blemish in being the interior of the location fang furrow to condense, it is easy to become the cause of a blemish to the case of the outside of a slot, i.e., heights. The slurry containing cerium oxide tends to melt into water, and since it can rinse easily and is hard to condense, it is suitable for the hard scouring pad (it is called a non-foamed scouring pad below) which consists of non-foamed resin. When the slurry of cerium oxide was used with a foaming scouring pad, since the holding power of the slurry within foaming of the processing side of a scouring pad was high, the cerium abrasive grain remained superfluously and the stability of polish had been affected. That is, there were a problem from which a polish rate changes with time amount, and a problem that the responsibility over the control operation of slurry supply was low. Compared with this, a non-foamed scouring pad has low holding power, and since effect of a front condition is not dragged, actuation of control of slurry concentration can be immediately reflected in polish nature, especially a polish rate, and can maintain the stable polish property.

[0019] Furthermore, in the combination of the slurry of a non-foamed scouring pad and oxidation silicon, although it was difficult to raise a polish rate, a high polish rate is obtained with combination with a cerium oxide slurry.

The [operation gestalt 3] book operation gestalt is polish equipment which is shown in drawing 2 and reduces a blemish. This invention is not limited to drawing 2 .

[0020] For a polish object and 3, as for a wafer and 5, a polish head and 4 are [10 / an abrasive material feed zone and 6] abrasive materials in drawing 2 . The polish head 3 rotates a wafer while holding a wafer 4. The polish object 10 sticks a scouring pad 2 on a surface plate 7. It is the rocking device in_ which the rotary motor which 30 makes rotate a polish head, the running torque detection device in_ which 31 detects the running torque of a rotary motor 30, and 41 give the load detection device of rocking movement (straight-line vibrational motion parallel to the processing side of a scouring pad) to the polish head 3, and 61 gives rocking movement, and the load device which 51 gives in a load to the polished surface-ed of a

wafer 4, and it has the load adjustment device in which a load can adjust, according to the load or the running torque signal received from the outside. 20 is a surface plate rotation motor and 21 is the running torque detection device of surface plate rotation.

[0021] As a scouring pad 2, what consists of non-foamed resin with slot structure is used for the front face. The polish head 3 is rotated with a rotary motor 30, and rotates the polish object 10 by the surface plate rotation motor 20. As for a wafer 4, a polished surface-ed is ground by operation of an abrasive material 6 and a scouring pad 2 in this process. This polish equipment operates as follows. During polish, in the surface plate torque detection device 21, the polish head torque detection device 31 detects the running torque of a surface plate rotation motor, and the running torque of the polish head rotation motor 30 and the rocking load detection device 41 detect a rocking load from the rocking device 61. The torque or the load signal from either of the surface plate torque detection device 21, the polish head torque detection device 31, or the rocking load detection device 41 is fed back to the load device 51, and the load device 51 fluctuates a load according to that difference as compared with the reference signal beforehand set up in this torque or a load signal. When torque or a load is larger than criteria, specifically mitigate a load, when conversely smaller than criteria, a load is made to increase, and the running torque or the rocking load by the load of the polished surface-ed produced as a result of the load which carries out in this way and the load device 51 gives is always maintained uniformly.

[0022] The object which controls torque or a load is the polish head rotation motor 30 preferably. Although the torque between polishes or a load was controlled by the above example from beginning to end, in simple, feedback control of torque or a load is not performed and it is good only in drawing 2 to even add the load to a polish head gradually. In this case, functions, such as a load adjustment device in which a load is adjusted according to an external signal required for feedback control, become unnecessary. Both drawing 3 shows the temporal response of the running torque of the load which a polish head when the polish member and the polish head are rotating by whenever [constant-speed] gives, and a polish head rotation motor. Drawing 3 (a) is the case where the load of constant value is given to polish initiation and coincidence, and drawing 3 (b) is the case where a load is made to increase from polish initiation to constant value gradually. Torque goes abruptly up immediately after polish initiation, and carries out the sudden fall of drawing 3 (a) after several seconds, and after about 10 seconds, it falls to constant value, is worn, and shows Lycium chinense. This shows the change rate from static friction to dynamical friction. On the other hand, torque of drawing 3 (b) is almost uniformly stable since immediately after polish initiation.

[0023] In consideration of the effect rapid increase of the torque immediately after polish initiation affects a polish member and a polish object, from the experimental result of being easy to generate a blemish on a polish object front face at the time of the abrupt change, this invention was performed on the radical of presumption whether a blemish can be prevented, when controlling torque as uniformly as possible. Consequently, not only the reduction in a blemish but an excessive vibration and generating of heat became possible [it being stopped and obtaining the stable polish result].

[0024] Although it is the example for which the polish head and the platen rotated in the upper explanation for migration, an effective thing cannot be overemphasized also when one of the two is rectilinear motion, for example, and the so-called relative motion is being performed. Furthermore, although the rocking device was prepared in the polish head side in drawing 2, it cannot be overemphasized that this may be prepared in a polish object side.

[0025]

[Example] The example below [an example 1] is equivalent to the operation gestalt 1. The hard scouring pad was produced as follows first. As an ingredient, they are epoxy base resin Epicoat 828 and Epicoat 871 (both oil-ized shell epoxy company make). Curing agent diamino diphenylmethane is mixed and stirred by the weight ratio 2.6:3.9:1, and it slushes into the mold of the size of phi800 mm, and is 150-degreeC. 8 Time amount heating was carried out and it was made to harden. Subsequently, they are pitch 0.5mm and a depth of 0.3mm to the above-mentioned epoxy resin front face by cutting. A spiral V groove (V include angle of 60 degrees), and width of face of 2mm and a depth of 0.5mm 5 The radial slot of a degree unit was formed and it considered as the scouring pad. The enlarged drawing of the cross-section configuration of **** is shown in drawing 5.

[0026] This scouring pad is stuck on a surface plate with a double-sided tape, it considers as a scouring pad, and the thermal oxidation film is 1 as a polish object. mum 6 formed The inch silicon wafer was fixed to the elastic membrane (backing film) of a polish head with surface tension, and it ground on the polish conditions shown below.

a polish condition and number of scouring pad rotations: -- 50rpm and number of polish head rotations: --

50rpm and rocking distance: -- 30mm and rocking frequency: -- 15 Both-way/a part - abrasive material: -- SEMI Supers25 made from Cabot 2 twice -- dilution (oxidation silicon slurry)

- Abrasive material flow rate : 200ml/The load to a part and a wafer; when 460 g/cm², thus the ground polish rate of a wafer were measured, a part for 200nm/was obtained. The blemish was not discovered when the polished surface was inspected with the flaw-detection machine.

Except for [example of comparison] slot structure, the scouring pad was produced on the same conditions as an example 1. Slot structure formed that it was spiral in the combination of a grid-like slot, as shown in the flat-surface enlarged drawing of drawing 6 .

[0027] It completely ground on the same conditions with the example 1 to the same wafer as an example 1 using this scouring pad. Thus, when the ground wafer was inspected with the flaw-detection machine, the blemish was sometimes able to see in the polished surface. The include angle to which a slot intersects a scouring pad is 2. It is because there is a part which has the acute angle of under a degree.

[Example 2] Except using the slurry which contains a cerium oxide particle 5% of the weight as an abrasive material to the same wafer as an example 1 with the scouring pad further produced on the same conditions as an example 1, when ground on the same conditions as an example 1, a part for 420nm/was obtained as a polish rate. The blemish was not discovered when the polished surface was inspected with the flaw-detection machine.

by weighting a polish head gradually according to the load device 51 shown in [example 3] drawing 2 shows to drawing 3 (b) -- as -- the load to a wafer -- 0 to 400 g/cm² up to -- except having made it increase gradually over about 10 seconds, it ground on the same same scouring pad [as the example 1 of a comparison], same wafer, and polish conditions.

[0028] Thus, the blemish was not discovered when the ground wafer was inspected with the flaw-detection machine. furthermore, the load to a wafer -- 0 to 400 g/cm² up to -- it was made to increase gradually over about 10 seconds, and also ground on the same polish conditions to the same wafer using the same scouring pad as an example 1.

[0029] Thus, the blemish was not discovered when the ground wafer was inspected with the flaw-detection machine. As mentioned above, by adding a load gradually, it prevented the load (torque) of rotation of a platen and a polish head increasing rapidly, and torque was almost fixed from the early stages of polish.

[0030] It cannot be overemphasized that the effectiveness of this invention does not change the load to a polish head in explanation of the gestalt of the above operation and an example even if it is a load to a polish object control or since it is a relative pressure although it changed gradually and being ground.

[0031]

[Effect of the Invention] According to this invention the above passage, it became possible to suppress generating of the blemish at the time of polish by the device of the slot structure of a non-foamed hard scouring pad. Furthermore, it is effective in the high polish rate which it not only can reduce generating of a blemish further with the combination of a non-foamed hard scouring pad and cerium oxide, but was not able to be attained until now using the oxidation silicon slurry being obtained. Furthermore, since the pressure at the time of polish is gradually raised so that torque may become fixed, there is outstanding effectiveness which can reduce generating of the blemish which the load to polish equipment decreases and vibration or the effect by heat not only decreases, but is easy to produce when a hard scouring pad is used. Furthermore, since he is trying for torque to become fixed from beginning to end during polish by carrying out feedback control of the pressure at the time of polish, there is outstanding effectiveness which the load to polish equipment decreases further and vibration or the effect by heat not only decreases further, but can reduce further the blemish at the time of using a hard scouring pad.

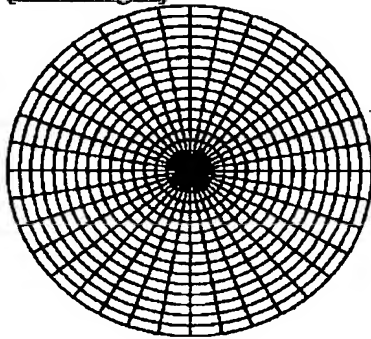
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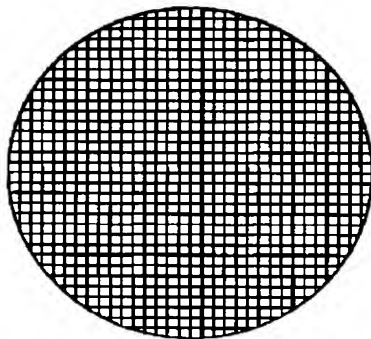
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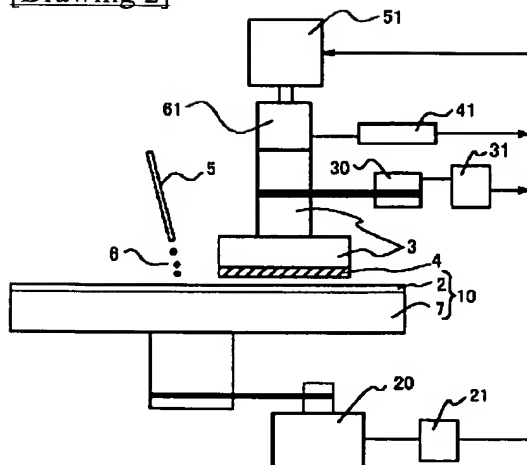
DRAWINGS

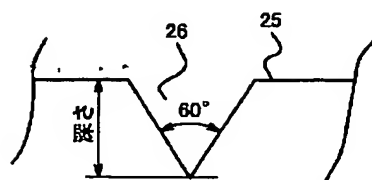
[Drawing 1]

(a)

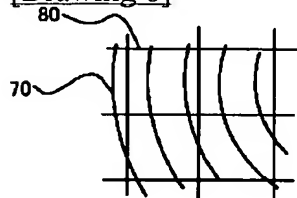


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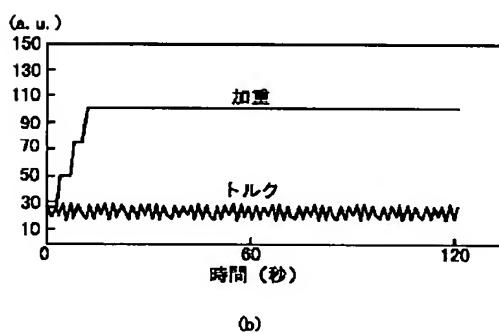
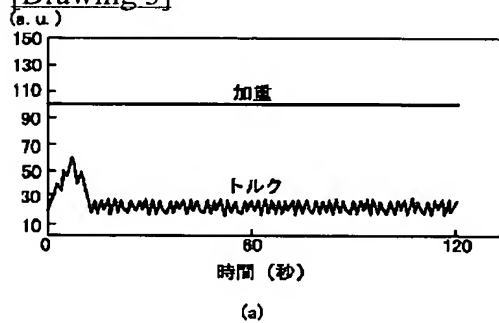
[Drawing 2][Drawing 5]



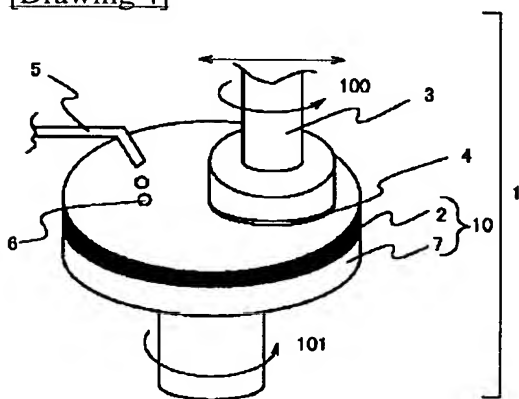
[Drawing 6]



[Drawing 3]



[Drawing 4]



[Translation done.]

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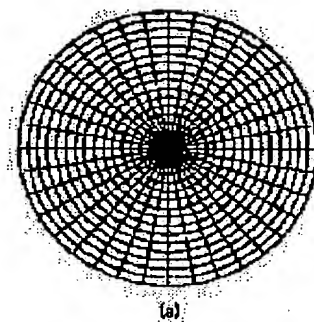
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NAKAHIRA NORIO
MATSUKAWA EIJI
MIYAJI AKIRA

(54) POLISHING MEMBER, POLISHING EQUIPMENT AND POLISHING METHOD

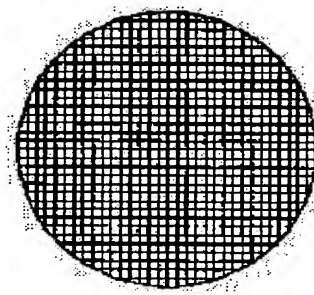
(57)Abstract:

PROBLEM TO BE SOLVED: To make occurrence of scratches difficult, and increase polishing rate by a method, wherein a surface is composed of non-foaming high molecular polymers, and a groove structure is provided on the surface, and when the grooves further intersect with each other, the intersecting angle is set to a prescribed angle or larger.

SOLUTION: A surface is composed of non-foaming high molecular polymers. Furthermore, a groove structure of the surface is made in combination with concentric and radiant grooves, or in combination with spiral and radial grooves, or only lattice grooves. For the case of groove structure, an intersecting angle becomes about 90° . In the case of the radial grooves, the intersecting angles at an intersecting point where a plurality of grooves constituting the radiant grooves intersect with each other are set to about 2° or larger. Namely, a sharp end will not be formed on the surface. For this reason, when the plurality of grooves are provided at equal angle intervals, it is preferable that the grooves be not formed exceeding 180 grooves. Furthermore, it is preferable that various lengths of the plurality of grooves be mixed with short or long ones and that terminals at a central side of the short grooves be disposed concentrically near the center.



(a)



(b)

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開2000-286218

(P2000-286218A)

(43) 公開日 平成12年10月13日 (2000. 10. 13)

(51) Int.Cl. ⁷	識別記号	F I	テマコード (参考)
H 0 1 L 21/304	6 2 2	H 0 1 L 21/304	6 2 2 F 3 C 0 5 8
B 2 4 B 37/00		B 2 4 B 37/00	6 2 2 K
			C
			B
			H
審査請求 未請求 請求項の数10 O L (全 7 頁)			

(21) 出願番号 特願平11-88157

(22) 出願日 平成11年3月30日 (1999. 3. 30)

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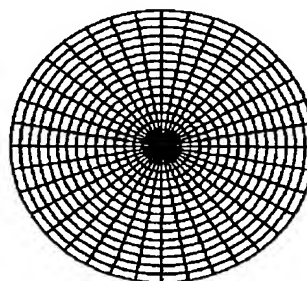
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(54) 【発明の名称】 研磨部材、研磨装置及び研磨方法

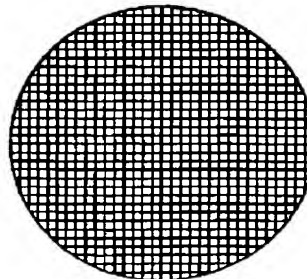
(57) 【要約】

【課題】 CMP装置に用いる、無発泡樹脂よりなる硬質研磨パッドは、パターンの段差解消は良いが、ウェハに傷が生じやすい傾向があり、また、研磨レートが発泡ポリウレタンよりなる研磨パッドに比べ低い傾向があった。これを改善して、傷の発生が起こりにくく、且つ研磨レートが高い研磨パッド、及び研磨装置、及び研磨方法を提供すること。

【解決手段】 本発明の研磨パッドは、その表面に螺旋溝または同心円溝、と格子溝を組み合わせ、溝の交差角を2度未満にし、またその表面に曲率半径が50nm以下の端部を持たない。また、本発明の研磨装置は研磨ヘッドまたはプラテンの移動負荷を一定に保っている。



(a)



(b)

【特許請求の範囲】

【請求項1】研磨対象物を保持する研磨ヘッドと研磨部材とを具え、前記研磨部材と前記研磨対象物との間に研磨剤を介在させた状態で、前記研磨部材と前記研磨対象物を相対移動させることにより、前記研磨対象物を研磨する研磨装置に用いる研磨部材に於いて、前記研磨部材が、少なくともその表面が無発泡の高分子重合体から成り、前記表面に溝構造が設けられ、更に前記表面に鋭い端部を有しないことを特徴とする研磨部材。

【請求項2】前記溝構造が、複数の交点を有する複数の溝から成り、前記交点に於ける溝が交差する角度が2度未満の鋭角を有しないことを特徴とする請求項1記載の研磨部材。

【請求項3】前記溝構造が、複数の交点を有する複数の溝から成り、前記溝の部分に曲率半径50 μ m未満の端部を有しないことを特徴とする請求項1記載の研磨部材。

【請求項4】前記溝構造が、螺旋状溝と放射状溝の組み合わせ、または同心円状溝と放射状溝の組み合わせ、または格子状溝の何れかから成ることを特徴とする請求項1、2、3何れか1項記載の研磨部材。

【請求項5】前記高分子重合体が、エポキシ樹脂、アクリル樹脂、ポリエステル樹脂、塩化ビニール樹脂、及びポリカーボネート樹脂の群から選ばれた何れか一つ以上の樹脂であることを特徴とする請求項1～4何れか1項記載の研磨部材。

【請求項6】研磨対象物を保持する研磨ヘッドと少なくともその表面が無発泡の高分子重合体から成る研磨部材とを用い、前記研磨部材と前記研磨対象物との間に研磨剤を介在させた状態で、前記研磨部材と前記研磨対象物を相対移動させることにより、前記研磨対象物を研磨する研磨方法に於いて、前記研磨剤が200nm以下の粒径の酸化セリウム粒子を含むことを特徴とする研磨方法。

【請求項7】前記研磨部材が、請求項1～5何れか1項記載の研磨部材であることを特徴とする請求項6記載の研磨方法。

【請求項8】研磨対象物を保持する研磨ヘッドと研磨部材とを用い、前記研磨部材と前記研磨対象物との間に研磨剤を介在させた状態で、前記研磨部材と前記研磨対象物を相対移動させることにより、前記研磨対象物を研磨する研磨方法に於いて、前記研磨対象物と前記研磨部材との間に加重を徐々に加える段階を有することを特徴とする研磨方法。

【請求項9】研磨対象物を保持する研磨ヘッドと研磨部材とを具え、前記研磨部材と前記研磨対象物との間に研磨剤を介在させた状態で、前記研磨部材と前記研磨対象物を相対移動させることにより、前記研磨対象物を研磨する研磨装置に於いて、前記研磨対象物と前記研磨部材との間に可変の荷重を与える加重機構と、研磨部材を移

動する研磨部材移動機構と、研磨対象物を移動する研磨対象物移動機構と、前記研磨部材移動機構と前記研磨対象物移動機構の片方または両方の移動の負荷を検出するためのそれぞれの負荷検出機構と、前記どちらか一方の負荷検出機構によって検出される負荷の値をもとに前記加重機構が与える加重を制御するためのフィードバック機構とを具えることを特徴とする研磨装置。

【請求項10】研磨対象物を保持する研磨ヘッドと研磨部材とを用い、前記研磨部材と前記研磨対象物との間に研磨剤を介在させた状態で、前記研磨部材と前記研磨対象物を相対移動させることにより、前記研磨対象物を研磨する研磨方法に於いて、前記研磨対象物または前記研磨部材の移動負荷が一定になるよう前記研磨対象物と前記研磨部材との間の荷重を調節する段階を有することを特徴とする研磨方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、例えばULSI等の半導体を製造するプロセスにおいて実施される半導体デバイスの平坦化研磨に用いるのに好適な研磨部材、研磨装置、及び研磨方法に関するものである。

【0002】

【従来の技術】半導体集積回路の高集積化、微細化に伴って半導体製造プロセスの工程が増加し複雑になってきている。これに伴い、半導体デバイスの表面は必ずしも平坦ではなくなっている。表面に於ける段差の存在は配線の段切れ、局所的な抵抗の増大などを招き、断線や電気容量の低下をもたらす。また、絶縁膜では耐電圧劣化やリークの発生にもつながる。

【0003】一方、半導体集積回路の高集積化、微細化に伴って光リソグラフィの光源波長は短くなり、開口数いわゆるNAが大きくなってきていることに伴い、半導体露光装置の焦点深度が実質的に浅くなってきている。焦点深度が浅くなることに対応するためには、今まで以上にデバイス表面の平坦化が要求されている。このような半導体表面を平坦化する方法としては、化学的機械的研磨(Chemical Mechanical Polishing又はChemical Mechanical Planarization、これよりCMPと呼ぶ)技術が有望な方法と考えられている。

【0004】CMPは図4に示すような装置を用いて行われている。図4で1はCMP装置、10は研磨体、3は研磨対象物保持部(研磨ヘッド)、4は研磨対象物(ウェハ)、5は研磨剤供給部、6は研磨剤である。研磨体10は、定盤7の上に研磨パッド2を貼り付けたものである。研磨パッド2としては、発泡ポリウレタンよりなるシート状のもの、あるいは表面に溝構造を有した無発泡樹脂よりなるものが使用されている。研磨ヘッド3は適当な手段により回転運動(100)し、また研磨体10は適当な手段により回転運動(101)する。この過程でウェハ4は、研磨剤6と研磨パッド2の作用により被

研磨面が研磨される。

【0005】CMP装置のプロセス安定性については、研磨パッドの処理枚数が増えた時にも安定した均一性、平坦性を示す他に、デバイスの断線や絶縁破壊の点からスクラッチ（傷）の無いことも要求されている。

【0006】

【発明が解決しようとする課題】従来のCMP装置に於いて、無発泡樹脂よりなる硬質研磨パッドは、パターン
の段差解消は良いが、ウェハに傷が生じやすい傾向があり、また、研磨レートが発泡ポリウレタンよりなる研
磨パッドに比べ低い傾向があった。本発明の目的は、傷の
発生が起こりにくく、且つ研磨レートが高い研磨パ
ッド、及び研磨装置、及び研磨方法を提供することにあ
る。

【0007】

【課題を解決するための手段】我々は、ウェハの傷発生
の原因を実験を繰り返して行い調査した。まず、研磨パ
ッド自体を調査した結果、無発泡樹脂よりなる硬質研
磨パッドの表面に形成された溝構造に問題があることを見つ
けた。この溝構造形成時にその表面にバリが生じること
がある。このバリは研磨中に剥がれてくることもある。
このバリが研磨対象物すなわちウェハ表面に傷を発生さ
せる。更にこのバリが核となりスラリーの凝集が生じ、
凝集したスラリーがウェハ表面を傷つけることも見つけ
た。

【0008】更に、研磨時の定盤回転モータのトルク、
研磨ヘッド回転モータのトルク、及び揺動機構の負荷を
測定した。その結果、研磨部材により研磨対象物である
ウェハを研磨するために、研磨開始時から研磨部材と研
磨対象物との間に所定の一定圧力を加え、研磨を行う
と、研磨ヘッドのトルク（負荷）は研磨開始時に急激に
上昇し、それから徐々に一定値に漸近し、研磨終了時に
下がることを見つけた。そしてこのトルクの急激な上昇
により、ウェハの被研磨面に熱が発生したり、ウェハが
余計な振動を起こしていた。更にトルクの急激な上昇
は、研磨パッドの表面に存在するスラリーや研磨カスの
凝集物等の異物との非定常的な接触を起こす確率を高め
る。我々は、これらがウェハの傷発生の大きな原因であ
ることを見つけた。これらは無発泡樹脂よりなる硬質研
磨パッドのみならず、軟らかいパッドにおいてもウェハ
の傷発生の原因となっていた。

【0009】そこで本発明は、以上の問題を解決するた
めに、第一に「研磨対象物を保持する研磨ヘッドと研磨
部材とを具え、前記研磨部材と前記研磨対象物との間に
研磨剤を介在させた状態で、前記研磨部材と前記研磨対
象物を相対移動させることにより、前記研磨対象物を研
磨する研磨装置に於いて、前記研磨部材が、少なくとも
その表面が無発泡の高分子重合体から成り、前記表面に
溝構造が設けられ、更に前記表面に鋭い端部を有しない
ことを特徴とする研磨部材（請求項

1）」を提供する。

【0010】第二に「前記溝構造が、複数の交点を有す
る複数の溝から成り、前記交点に於ける溝が交差する角
度が2度未満の鋭角を有しないことを特徴とする請求項
1記載の研磨部材（請求項2）」を提供する。第三に
「前記溝構造が、複数の交点を有する複数の溝から成
り、前記溝の部分に曲率半径50 μ m未満の端部を有し
ないことを特徴とする請求項1記載の研磨部材（請求項
3）」を提供する。

【0011】第四に「前記溝構造が、螺旋状溝と放射状
溝の組み合わせ、または同心円状溝と放射状溝の組み合
せ、または格子状溝の何れかから成ることを特徴とする
請求項1、2、3何れか1項記載の研磨部材（請求項
4）」を提供する。第五に「前記高分子重合体が、エポ
キシ樹脂、アクリル樹脂、ポリエステル樹脂、塩化ビニ
ール樹脂、及びポリカーボネート樹脂の群から選ばれた
何れか一つ以上の樹脂であることを特徴とする請求項1
～4何れか1項記載の研磨部材（請求項5）」を提供す
る。

【0012】第六に「研磨対象物を保持する研磨ヘッド
と少なくともその表面が無発泡の高分子重合体から成る
研磨部材とを用い、前記研磨部材と前記研磨対象物との
間に研磨剤を介在させた状態で、前記研磨部材と前記研
磨対象物を相対移動させることにより、前記研磨対象物
を研磨する研磨方法に於いて、前記研磨剤が200nm
以下の粒径の酸化セリウム粒子を含むことを特徴とする
研磨方法（請求項6）」を提供する。

【0013】第七に「前記研磨部材が、請求項1～5何
れか1項記載の研磨部材であることを特徴とする請求項
6記載の研磨方法（請求項7）」を提供する。第八に
「研磨対象物を保持する研磨ヘッドと研磨部材とを用
い、前記研磨部材と前記研磨対象物との間に研磨剤を介
在させた状態で、前記研磨部材と前記研磨対象物を相対
移動させることにより、前記研磨対象物を研磨する研磨
方法に於いて、前記研磨対象物と前記研磨部材との間に
加重を徐々に加える段階を有することを特徴とする研磨
方法（請求項8）」を提供する。

【0014】第九に「研磨対象物を保持する研磨ヘッド
と研磨部材とを具え、前記研磨部材と前記研磨対象物と
の間に研磨剤を介在させた状態で、前記研磨部材と前記
研磨対象物を相対移動させることにより、前記研磨対象
物を研磨する研磨装置に於いて、前記研磨対象物と前記
研磨部材との間に可変の荷重を与える加重機構と、研磨
部材を移動する研磨部材移動機構と、研磨対象物を移動
する研磨対象物移動機構と、前記研磨部材移動機構と前
記研磨対象物移動機構の片方または両方の移動の負荷を
検出するためのそれぞれの負荷検出機構と、前記どちら
か一方の負荷検出機構によって検出される負荷の値をも
とに前記加重機構が与える加重を制御するためのフィー
ドバック機構とを具えることを特徴とする研磨装置（請

求項9)」を提供する。

【0015】第十に「研磨対象物を保持する研磨ヘッドと研磨部材とを用い、前記研磨部材と前記研磨対象物との間に研磨剤を介在させた状態で、前記研磨部材と前記研磨対象物を相対移動させることにより、前記研磨対象物を研磨する研磨方法に於いて、前記研磨対象物または前記研磨部材の移動負荷が一定になるよう前記研磨対象物と前記研磨部材との間の荷重を調節する段階を有することを特徴とする研磨方法（請求項10）」を提供する。

【0016】

【発明の実施の形態】【実施形態1】本実施形態の研磨パッドは、その表面に形成した溝構造にバリがない。そのために、第一にバリが発生しない溝構造形成法を取ること、そのために溝形成が終わった研磨パッドの表面を馴染め処理をすることも重要であるが、本発明では研磨中に研磨パッドから剥がれてくるバリをなくすることに着目した。

【0017】本実施形態の研磨パッドの溝構造は、溝構造を構成する複数の溝が交差する交点での交差角度が2度以下の鋭角を持たない。これによって、研磨中に剥がれてくるバリを大きく低減できるのである。このためには、同心円状と放射状の溝の組み合わせ（図1（a））、螺旋状と放射状の組み合わせ、あるいは格子溝のみの構造（図1（b））が最も有効である。これらの溝構造の場合、交差角度は90度になる。放射状の溝の場合には、放射状の溝を構成する複数の溝が交差する交点（通常は研磨パッドの中央部）での交差角度が2度以上の角度を有するようにする。このためには、放射状の溝を構成する複数の溝を等角度間隔で設けた場合は、複数の溝を180本を超えて形成しないことが好ましい。更に放射状の溝を構成する複数の溝の長さを長短交互に取り混ぜ、研磨パッドの中央付近で、放射状の溝を構成する短い方の複数の溝の研磨パッドの中心側の末端を同心円状に配置することも好ましい。このように、研磨パッドの加工面には鋭い端部を有しないことが好ましく、具体的には曲率半径50μm未満の端面を研磨パッドの加工面に有しないことが好ましい。

【実施形態2】本実施形態は、実施形態1と組み合わせで用いられるスラリーである。

【0018】本スラリーは、凝集を起こしにくい。凝集し難いスラリーとしては酸化セリウムを含んだスラリーが好ましく用いられる。CMPの誘電体の研磨には一般に二酸化珪素（SiO₂）を含んだスラリーが多く使用されている。このスラリーは安定性に優れているが、凝集してガラスを形成しやすい性質を持つ。この凝集物は研磨パッドの表面に凝集する。凝集する場所が溝の内部の場合には凝集物は傷の原因にならないが、溝の外側、即ち凸部の場合には傷の原因になりやすい。酸化セリウムを含んだスラリーは水に溶けやすく、容易に水洗でき

凝集し難いため、無発泡樹脂よりなる硬質研磨パッド

（以下無発泡研磨パッドと呼ぶ）に適している。発泡研磨パッドで酸化セリウムのスラリーを使用した場合、研磨パッドの加工面の発泡内でのスラリーの保持力が高いため、過剰にセリウム砥粒が残り、研磨の安定性に影響を及ぼしていた。即ち、時間と共に研磨速度が変化する問題や、スラリー供給の制御操作に対しての応答性が低い問題があった。これに比べ、無発泡研磨パッドは保持力が低く、前の状態の影響を引きずらないため、スラリー濃度の制御の操作が直ちに研磨性、特に研磨速度に反映し、安定した研磨特性を保つことが出来る。

【0019】更に、無発泡研磨パッドと酸化珪素のスラリーの組み合わせでは、研磨レートを高めることは困難であったが、酸化セリウムスラリーとの組み合わせにより高い研磨速度が得られる。

【実施形態3】本実施形態は、図2に示され、傷を低減する研磨装置である。本発明は図2に限定されない。

【0020】図2で10は研磨体、3は研磨ヘッド、4はウェハ、5は研磨剤供給部、6は研磨剤である。研磨ヘッド3はウェハ4を保持すると共に、ウェハを回転する。研磨体10は、定盤7の上に研磨パッド2を貼り付けたものである。30は研磨ヘッドを回転させる回転モータ、31は回転モータ30の回転トルクを検出する回転トルク検出機構、41は揺動運動（研磨パッドの加工面に平行な直線振動運動）の負荷検出機構、61は研磨ヘッド3に揺動運動を与える揺動機構、51はウェハ4の被研磨面に荷重を与える加重機構であり、外部から受信された負荷または回転トルク信号に応じて加重を調整可能な加重調整機構を具える。20は定盤回転モータ、21は定盤回転の回転トルク検出機構である。

【0021】研磨パッド2としては、表面に溝構造を有した無発泡樹脂よりなるものが使用されている。研磨ヘッド3は回転モータ30により回転運動し、また研磨体10は定盤回転モータ20により回転運動する。この過程でウェハ4は、研磨剤6と研磨パッド2の作用により被研磨面が研磨される。本研磨装置は以下のように動作する。研磨中に定盤トルク検出機構21は定盤回転モータの回転トルクを、研磨ヘッドトルク検出機構31は研磨ヘッド回転モータ30の回転トルクを、そして揺動負荷検出機構41は揺動機構61から揺動負荷を検出する。定盤トルク検出機構21または研磨ヘッドトルク検出機構31または揺動負荷検出機構41の何れかからのトルクまたは負荷信号は加重機構51にフィードバックされ、加重機構51はこのトルクまたは負荷信号を予め設定された基準信号と比較し、その差分に応じて加重を増減する。具体的にはトルクまたは負荷が基準よりも大きいときには加重を軽減し、逆に基準よりも小さいときには加重を増加させ、このようにして加重機構51の与える加重の結果生じる被研磨面の荷重による回転トルクまたは揺動負荷は常に一定に維持される。

【0022】トルクまたは負荷を制御する対象は好ましくは研磨ヘッド回転モータ30である。以上の例では、研磨の間トルクまたは負荷が終始制御されたが、もっと簡略的に、トルク、または負荷のフィードバック制御を行わなくて、単に図2に於いて、研磨ヘッドへの加重を段階的に加えるのみでも良い。この場合は、フィードバック制御に必要な外部信号に応じて加重を調整する加重調整機構、等の機能は不要となる。図3は研磨部材と研磨ヘッドとが共に定速度で回転しているときの、研磨ヘッドの与える加重と研磨ヘッド回転モータの回転トルクの時間的変化を示す。図3(a)は、研磨開始と同時に一定値の加重を与えた場合であり、図3(b)は、研磨開始から段階的に徐々に加重を一定値まで増加させた場合である。図3(a)は、トルクが、研磨開始直後に急上昇し、数秒後に急低下し、約10秒後に一定値に落ち着くことを示している。これは静止摩擦から動摩擦への切り替わりを示す。これに対して図3(b)は、トルクが、研磨開始直後からほぼ一定に安定している。

【0023】本発明は研磨開始直後のトルクの急激な増大が、研磨部材と研磨対象物に及ぼす影響を考慮し、例えばその急激な変化時に研磨対象物表面に傷が発生しやすい等の実験的結果から、トルクを出来るだけ一定に制御すれば傷を防止できるのではないかと推定の基に行われた。その結果、傷の減少だけでなく、余計な振動や熱の発生が抑えられて、安定した研磨結果を得ることが可能となった。

【0024】上の説明では研磨ヘッド、プラテンともに移動のために回転を行った例であるが、例えば片方が直線運動の場合でも、所謂相対運動を行っている場合にも有効であることは言うまでもない。更に図2では揺動機構を研磨ヘッド側に設けたが、これを研磨体側に設けても良いことは言うまでもない。

【0025】

【実施例】
【実施例1】以下の実施例は実施形態1に対応する。まず硬質研磨パッドを以下のように作製した。材料として、エポキシ主剤エポコート828、エポコート871(共に油化シェルエポキシ社製)と硬化剤アミノジフェニルメタンを重量比2.6:3.9:1で混合、攪拌し、φ800mmのサイズの型に流し込み、150℃で8時間加熱し硬化させた。次いで、切削加工で、上記エポキシ樹脂表面にピッチ0.5mm、深さ0.3mmの螺旋状V溝(V角度60°)と、幅2mm、深さ0.5mmの5度刻みの放射状溝を形成し、研磨パッドとした。図5に本溝の断面形状の拡大図を示す。

【0026】この研磨パッドを定盤に両面テープで貼り付け研磨パッドとし、研磨対象物として熱酸化膜が1μm形成された6インチシリコンウェハを表面張力で研磨ヘッドの弾性膜(バックングフィルム)に固定し、以下に示す研磨条件で研磨を行った。

研磨条件

- ・研磨パッド回転数:50rpm
- ・研磨ヘッド回転数:50rpm
- ・揺動距離:30mm
- ・揺動頻度:15 往復/分
- ・研磨剤:Cabot社製SEMI Supers25を2倍に希釈(酸化珪素スラリー)
- ・研磨剤流量:200ml/分
- ・ウェハへの荷重:460q/cm²

このように研磨されたウェハの研磨速度を測定したところ、200nm/分が得られた。研磨面を傷検査機で検査したところ、傷は発見されなかった。

【比較例】溝構造を除いて、実施例1と同じ条件で研磨パッドを作製した。溝構造は、図6の平面拡大図で示すように、螺旋状と格子状溝の組み合わせで形成した。

【0027】この研磨パッドを用い、実施例1と同じウェハに対し、実施例1と全く同一条件で研磨した。このように研磨されたウェハを傷検査機で検査したところ、研磨面に時々傷が見受けられた。研磨パッドに溝が交差する角度が2度未満の鋭角を有する部分があるためである。

【実施例2】更に実施例1と同一条件で作製した研磨パッドで、実施例1と同じウェハに対し、研磨剤として酸化セリウム粒子を5重量%含有するスラリーを用いる以外は実施例1と同じ条件で研磨したところ、研磨レートとして420nm/分が得られた。研磨面を傷検査機で検査したところ、傷は発見されなかった。

【実施例3】図2に示す加重機構51により研磨ヘッドに段階的に加重することにより、図3(b)に示すように、ウェハへの荷重を0から400q/cm²まで約10秒かけて段階的に増加させた以外は、比較例1と同一研磨パッド、同一ウェハ、同一研磨条件で研磨した。

【0028】このように研磨されたウェハを傷検査機で検査したところ、傷は発見されなかった。更に、ウェハへの荷重を0から400q/cm²まで約10秒かけて段階的に増加させる他、実施例1と同一研磨パッドを用い、同一ウェハに対して、同一研磨条件で研磨した。

【0029】このように研磨されたウェハを傷検査機で検査したところ、傷は発見されなかった。以上のように、段階的に加重を加えることによって、プラテン及び研磨ヘッドの回転の負荷(トルク)が急増するのを防ぎ、トルクは研磨初期からほぼ一定であった。

【0030】以上の実施の形態、実施例の説明では研磨ヘッドへの加重を制御または段階的に変えて研磨したが、相対的な圧力であることから、研磨体への荷重であっても本発明の効果は変わらないことは言うまでもない。

【0031】

【発明の効果】以上の通り、本発明によれば、無発泡硬質研磨パッドの溝構造の工夫により研磨時の傷の発生を抑えることが可能となった。更に、無発泡の硬質研磨パ

ッドと酸化セリウムの組み合わせにより傷の発生を更に低減できるばかりでなく、酸化珪素スラリーを使って今まで達成できなかったような高い研磨レートが得られる効果もある。更に、研磨時の圧力をトルクが一定になるように徐々に上げている為、研磨装置への負荷が少なくなり、振動あるいは熱による影響が少なくなるばかりでなく、硬い研磨パッドを用いた場合に生じやすい傷の発生を低減できる優れた効果がある。更に、研磨時の圧力をフィードバック制御することによって、研磨の間、終始トルクが一定になるようにしているため、研磨装置への負荷が更に少なくなり、振動あるいは熱による影響が更に少なくなるばかりでなく、硬い研磨パッドを用いた場合の傷を更に低減できる優れた効果がある。

【図面の簡単な説明】

【図1】本発明におけるCMP研磨装置の研磨パッドの平面概念図である。

【図2】本発明のトルク検出機構を持った研磨装置の概念図である。

【図3】本発明の実施形態3、実施例3に示したトルク一定の段階加圧の状態を示す図である。

【図4】従来例のCMP装置の概念を示す図である。

【図5】本発明の実施例1～3で用いた研磨パッドの溝の断面形状を示す図である。

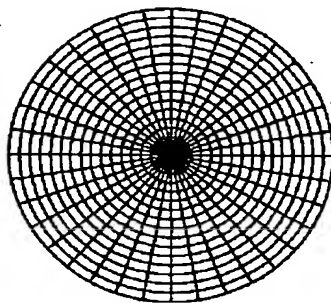
【図6】従来例の研磨パッドの、螺旋状溝と格子状溝と*

*を組み合わせた溝構造の部分的な平面拡大図を示す図である。

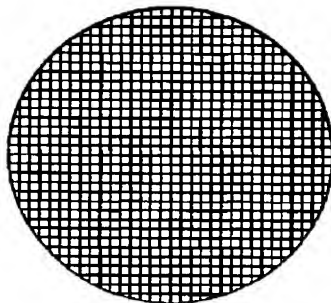
【符号の説明】

- 1 CMP装置
- 2 研磨部材（研磨パッド）
- 3 研磨ヘッド
- 4 ウェハ（研磨対象物）
- 5 研磨剤供給部
- 6 スラリー（研磨剤）
- 7 定盤
- 10 研磨体
- 20 定盤回転モータ
- 21 トルク検出機構（定盤）
- 25 研磨パッド表面
- 26 研磨パッド溝
- 30 研磨ヘッド回転モータ
- 31 トルク検出機構（研磨ヘッド）
- 41 負荷検出機構（揺動）
- 51 加重機構
- 61 揺動機構
- 70 螺旋状溝
- 80 格子状溝
- 100 回転運動を示す
- 101 回転運動を示す

【図1】

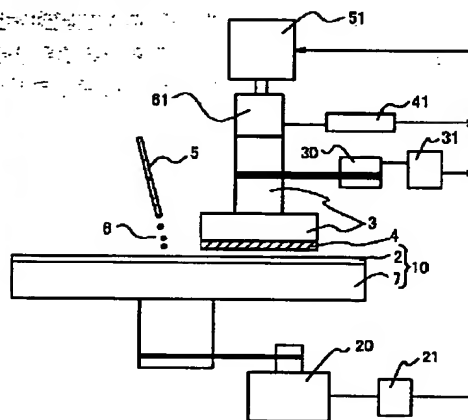


(a)

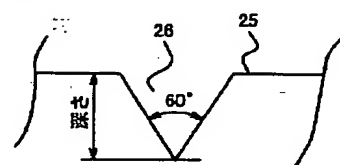


(b)

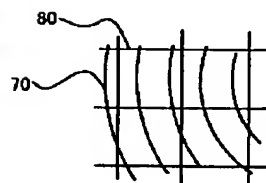
【図2】



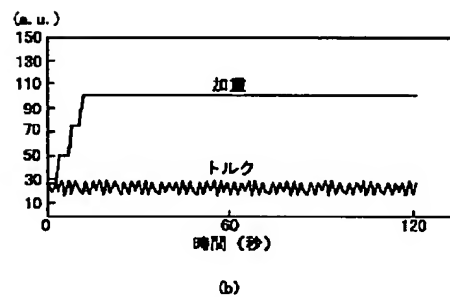
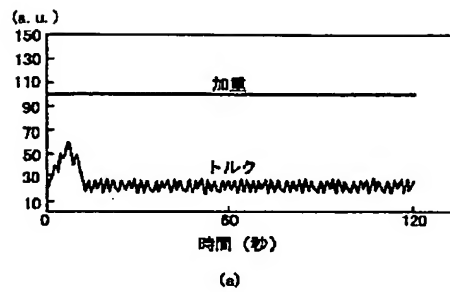
【図5】



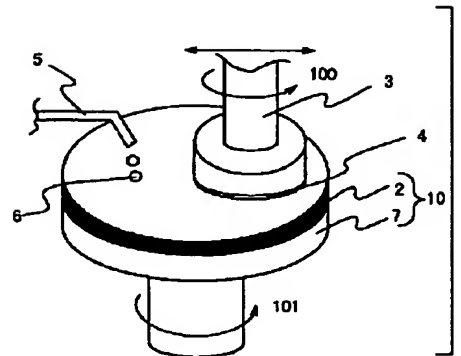
【図6】



【図3】



【図4】



フロントページの続き

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Fターム(参考) 3C058 AA07 AA09 AA12 BA06 BC01
BC02 BC03 CB02 CB03 CB10
DA02 DA17

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